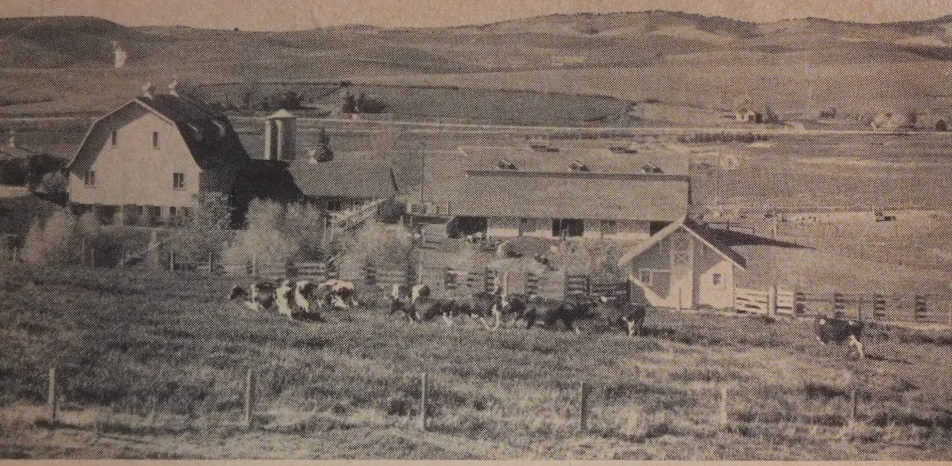

MOSCOW, JUNE 1944

EXTENSION BULLETIN 118
(Revised)

# Farm Dairy Structures

UNIVERSITY OF IDAHO
COLLEGE OF AGRICULTURE
EXTENSION DIVISION

E. J. IDDINGS
*Director*

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# Farm Building Plan Service

THE Agricultural Engineering Department of the University of Idaho, Moscow, Idaho, maintains a complete farm building plan service. The available plans are listed in Extension Circular No. 65, *Farm Building and Equipment Plans.* This service also includes the prints shown in U. S. Department of Agriculture publication No. 319, *Plans for Farm Buildings for the Western States.* A catalog describing these plans is available at each county extension agent's office.

The plan layouts shown in the bulletin are not intended to be used for construction. Working drawings of these plans and additional plans as listed on the last page of the bulletin may be obtained through your county extension agent, or direct from the Department of Agricultural Engineering. When ordering prints of plans please give the plan number. For additional information on the prints shown in this bulletin or the building plan service, address the Department of Agricultural Engineering, University of Idaho, Moscow, Idaho.

COOPERATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS
OF THE STATE OF IDAHO, UNIVERSITY OF IDAHO COLLEGE OF
AGRICULTURE AND UNITED STATES DEPARTMENT
OF AGRICULTURE COOPERATING

AGRICULTURAL ENGINEERING AND DAIRY HUSBANDRY

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# Farm Dairy Structures

*By*

HOBART BERESFORD, D. R. THEOPHILUS, KENNETH R. FROST, D. L. FOURT, G. C. ANDERSON*

FARM dairy structures and equipment are important in the successful management of dairy cattle. These should be suitable to Idaho conditions, economical and of durable construction, labor saving in use, and should meet the sanitary requirements for producing high quality milk. Overhead must be kept down if income is to be maintained but, on the other hand, additional investment may be required before production can be expanded to where the labor income from the dairy unit will be satisfactory to the farmer.

The use of good building materials, together with careful planning and good construction, are to be recommended as a guarantee of longer structural life and lower building maintenance costs. In attempting to meet the needs of dairy farmers in Idaho, the dairy structure plans selected for this bulletin show a wide variation in the amount of money invested. For example, the open shelter shed with stanchions may represent an investment of only $25 per cow, compared with $125 per cow for the milking barn with overhead feed storage.

The comparative costs of various types of dairy structures are given in Table 1. Three methods are used in presenting these costs, the first being the unit-space cost based on the number of animals accommodated by the structure; the second and third costs are based on the areas and volumes involved.

The open shelter shed provides the lowest unit-space cost for handling dairy cattle, averaging about $25 per cow where volume costs run about 5 cents per cubic foot. This includes provision for a rotation use of the stanchions, or the walk-through method for machine milking. Milking barns without overhead storage average about $125 per cow where calf pens and maternity stalls are provided and frame construction is used. Overhead storage and fire-safe construction add to the unit-space cost, which should be credited with the saving in insurance and labor. As in the case of all farm buildings, the use of native materials and farm labor for the construction results in the greater value for the building dollar.

There has been a demand for information concerning the type of structure that would meet the requirements of milk ordinances in various communities, particularly the ordinance prepared by the United States Public Health Service and the Bureau of Dairy Industry of the United States Department of Agriculture. Many local milk ordinances are now being patterned after this Public

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Health Service ordinance and code, with the result that by meeting the requirements of the proposed standard code, new or rebuilt barns and milkhouses can meet satisfactory compliance in most communities for many years. Before building or remodeling, it is suggested that the requirements of the local milk ordinance be carefully determined.

The subject of farm dairy structures covers such a large field that only the principal features of modern construction and equipment suitable to Idaho conditions are presented in this bulletin. The basis of all recommendations or suggestions for specific items is the Public Health Service ordinance, the requirements of which are given in quotations. The suggested recommendations for ventilation, lighting, and sanitation may easily be modified to satisfy the requirements of any local milk code or ordinance.

**TABLE 1**

**Farm Dairy Structures***

| Name of building and class of construction | Unit space | Square foot | Cubic feet |
|---|---|---|---|
| Milkhouses | Cost per cow | | |
| First | $15 to $20 | $1.50 to $2.50 | 15c to 20c |
| Second | $ 5 to $10 | $1.00 to $2.00 | 12c to 15c |
| Feed storage and shelter shed | Cost per cow | | |
| First | $30 to $40 | $0.30 to $0.50 | 3c to 5c |
| Second | $20 to $30 | $0.20 to $0.30 | 2c to 3c |
| Milking barns | Cost per cow | | |
| First | $100 to $150 | $1.50 to $2.00 | 15c to 25c |
| Second | $ 75 to $100 | $1.00 to $1.50 | 12c to 15c |
| | Cost per animal | | |
| Bull barns | $350 to $400 | $2.00 to $3.00 | 20c to 25c |
| | Cost per pen | | |
| Calf barns | $125 to $175 | $1.50 to $2.00 | 15c to 20c |

* Prewar prices.

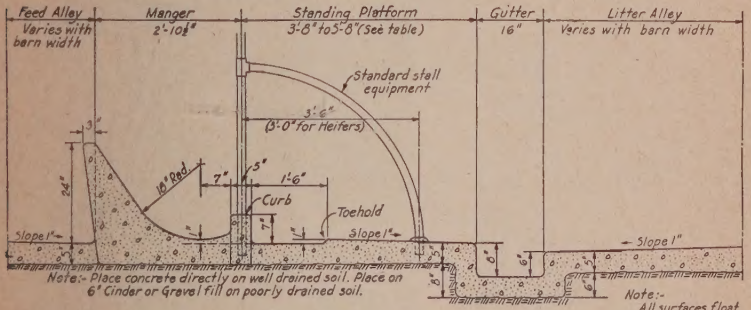
## Foundation and Floors

"The floors and gutters of such parts of all dairy barns in which cows are milked shall be constructed of concrete or other approved impervious and easily cleaned material, provided that if the milk is to be pasteurized tight wood may be used, shall be graded to drain properly, and shall be kept clean and in good repair. No horses, pigs, fowl, calves, etc., shall be permitted in parts of the barn used for milking."—*U. S. Public Health Service Milk Ordinance.*

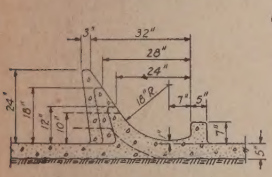
Concrete is the ideal material for footings and foundation walls, ranging in thickness from 6 to 12 inches for the various-sized structures. The broadened base of the foundation or the footing should be from 12 to 20 inches wide to prevent settlement. The founda-

tion should be carried below grade to a depth sufficient to place the footing on firm soil of uniform bearing capacity. It is recommended that the concrete foundation wall extend at least 1 foot above grade to keep the framing away from the damp ground. In many dairy barns the concrete wall is carried 4 feet above ground, which gives a permanent, sanitary, and easily cleaned lower wall for the barn.

Floors of concrete are watertight and nonabsorbent; they disinfect easily and thoroughly. Their smooth, hard surfaces are easily kept clean and do not retain stable odors, which taint the milk. Placing concrete floors in dairy barns is a job which the dairyman can usually undertake with his own labor when other farm work is not pressing.




CROSS SECTION




ALTERNATE MANGER DETAILS

STANDARD STALL DIMENSIONS
(For various breeds)

| Breeds | Width | Length of Platform | | |
|---|---|---|---|---|
| | | Small | Medium | Large |
| Holstein | 3'-6" to 4'-0" | 4'-10" | 5'-2" | 5'-8" |
| Shorthorn | 3'-6" to 4'-0" | 4'-8" | 5'-0" | 5'-6" |
| Ayrshire | 3'-6" to 3'-8" | 4'-6" | 5'-0" | 5'-6" |
| Guernsey | 3'-4" to 3'-6" | 4'-6" | 4'-10" | 5'-4" |
| Jersey | 3'-4" to 3'-6" | 4'-4" | 4'-8" | 5'-0" |
| Heifers | 2'-9" to 3'-2" | 3'-8" | 3'-10" | 4'-2" |

Figure 1.—Standard dairy floor. (Plan .721-26)

## Construction Planning

The stalls, feed, and litter alleys should be planned to save time and to reduce labor in caring for the animals. Figure 1 gives standard stall dimensions for various breeds, which will aid in planning the proposed floor arrangement. Generally, the double-row arrangement of cows is the most economical.

If the barn is being remodeled, it is usually necessary to leave the supporting posts and plan the arrangement accordingly. The floor should be raised to the required level and all fills should be thoroughly tamped to provide a firm base for the concrete. If the subbase for the floor is not well-drained, a tamped fill of cinders of 6 or 8 inches is recommended. The shape of the surface of the subbase should conform approximately to the finished floor, as less concrete will be required. The various floor levels may be

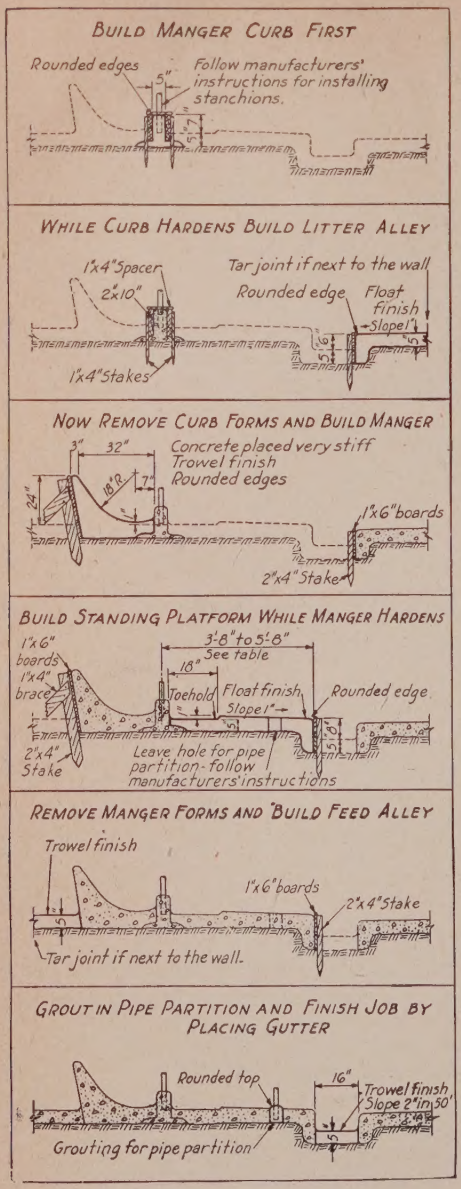



Figure 2.—How to build the floor (Cross section shows one half of the floor). (Plan .721-27)

indicated by stakes placed at regular intervals and by marks on walls and columns.

The floor should be planned so that the litter alley will be on a level with the door sills. The litter alley should slope toward the gutter; see Figure 1 for more detailed information. The manger and gutter should slope 1 inch in 25 feet toward one end of the barn where a suitable drain is provided. The standing platform should also slope toward the gutter.

No attempt should be made to pour the entire floor in one monolithic slab, as this would be too difficult. If instructions in Figure 2 are followed, no difficulty will be experienced in building the floor. Forms for curbs, mangers, and gutters should be of smooth lumber, oiled, carefully set to grade, and held in place with stakes to prevent bulging. The dairy barn fixtures, such as stanchions, stall partitions, watering cups, and other modern steel equipment used in the barn should be installed according to the manufacturer's instructions before placing the concrete floor.

### Placing the Concrete

Placing, finishing, and curing are all highly important items in the building of a concrete floor. The aggregate should be clean, hard, and free from organic matter. All materials

should be measured accurately and mixed thoroughly for each batch. Mixing should continue for at least 1 minute after all the materials have been placed in the mixer.

The recommended mix for building watertight, sanitary dairy floors is one containing a total of 5½ gallons of water per sack of cement plus such amounts of dry sand and gravel as will produce a workable mixture. Less water is added when the sand and gravel are moist, since 1 cubic foot of moist aggregate contains approximately 1 quart of water which is free to act on the cement. As a trial batch, combine 1 sack of cement, 2 cubic feet of sand, 3 cubic feet of gravel, (1:2:3 mix) and 5½ gallons of water, if the aggregate is dry. It may be necessary to change the proportions of sand and gravel slightly to obtain a smooth workable mix. The mix should be quite stiff, requiring some tamping to settle it in the forms. Especially is this important when forming the manger. For each 100 square feet of floor area, based on a floor approximately 5 inches thick and a 1:2:3 mix, the following quantities of materials are required: 11 sacks of cement, 4/5 cubic yards of sand, and 1 1/5 yards of gravel.

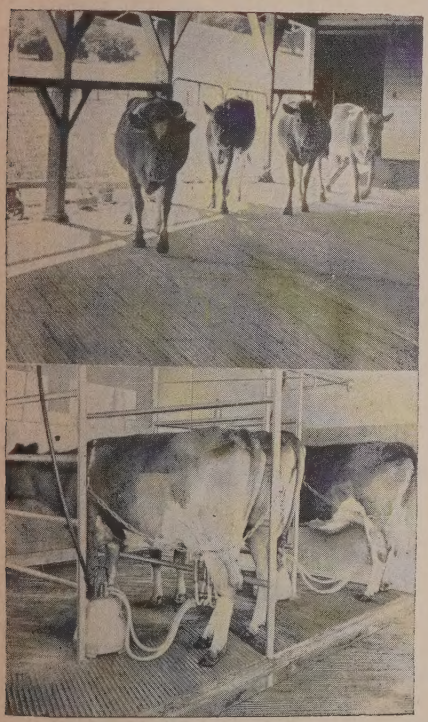


Figure 3.—Corrugated floors for dairy stables. (Plan .72012-1)

When the forms are filled, the surface is evened up with a strike board which is worked back and forth cutting off the high and filling in the low places. After the concrete has been struck, it is allowed to stand until it has stiffened up slightly before finishing. The standing platform and litter alleys are finished with a wooden float which is worked back and forth over the surface, producing a gritty, nonslip surface. An objection often raised against concrete floors is that they are too slick for men and cattle. This objection may be overcome by scoring the surface with a trowel or by corrugating the floor with a suitable float, thus producing a nonslip floor similar to the ones illustrated in Figure 3. In feed alleys, mangers, troughs, and the bottoms of gutters, where

a smooth surface is desired, the floated surface is later finished with a steel trowel. An edging tool is used to round all edges in mangers, curbs, and gutters. The proper curing of concrete is highly important, as it increases the hardness and the water-tightness. The doors and windows of the barn should be kept closed and the surface of the concrete kept moist by sprinkling for at least 10 days to cure the concrete properly.

### Walls and Ceilings

"The walls and ceilings of all dairy barns shall be whitewashed once each year or painted once every two years, or oftener if necessary, or finished in an approved manner, and shall be kept clean and in good repair. In case there is a second story above that part of the barn in which cows are milked, the ceilings shall be tight. If the feed room adjoins the milking space, it shall be separated therefrom by a dust-tight partition and door. No feed shall be stored in the milking portion of the barn."—*U. S. Public Health Service Milk Ordinance.*

It is much easier to keep a dairy barn sanitary, and also improves the appearance of the barn if it is completely ceiled inside. Shiplap or plywood may be used for this purpose. For more detailed information on dairy-barn construction, refer to U. S. Department of Agriculture Farmers' Bulletin No. 1342, *Dairy-Barn Construction,* and Leaflet No. 232, *A Wartime Dairy Barn.*

### Air Space and Ventilation

"Such sections of all dairy barns where cows are kept or milked shall be well ventilated and shall be so arranged as to avoid overcrowding."—*U. S. Public Health Service Milk Ordinance.*

The air space in a dairy barn for Idaho conditions should not exceed 500 or 600 cubic feet per cow. If more space than this is provided, the barn may be uncomfortably cold in the winter. The ceiling height for dairy stables should be 8½ feet, measured from the alley at the rear of the stall to the underside of the joist.

To maintain a satisfactory standard of air purity, each 1,000-pound dairy cow, when stabled in the barn, should be provided with approximately 3,600 cubic feet of air per hour. To supply this amount of fresh air for each cow, a well-designed ventilating system of the gravity or forced-air circulation type is necessary. If a gravity system is used, it will be necessary to provide 1/5 square foot of outtake flue area for each cow. An outtake flue 1 foot square is sufficient for five cows. Generally a single outtake flue is adequate if properly designed. Air should enter the barn through special fresh-air intakes. The total area of the intake flues should be approximately equal to the area of the outtake flue. However, a number of small intakes should be used, spaced from 7 to 12 feet along the wall, so as not to cause drafts.

If the dairyman wishes to have absolute control of the ventilation in the dairy barn, regardless of outside atmospheric conditions, it is recommended that he consider a system of forced ventilation operated by electric fans, which may be controlled either manually or automatically. There are several excellent makes of electrical ventilating systems now on the market for this type of service.

For more detailed information, refer to U. S. Department of Agriculture Farmers' Bulletin No. 1393, *Principles of Dairy-Barn Ventilation.*

### Lighting

> "A dairy or milking barn shall be required, and in such sections thereof where cows are milked, windows shall be provided and kept clean and so arranged as to insure adequate light properly distributed, and when necessary shall be provided with adequate supplementary artificial light."—*U. S. Public Health Service Milk Ordinance.*

Four square feet of window glass per cow is desirable in the dairy or milking barn, and a larger amount is preferable except in cold climates. For pens, 1 square foot of window-glass area should be provided for each 25 square feet of floor area. Windows should always be longer than they are wide so that the sun's light will cover a greater floor area, and will penetrate a greater depth into the barn. Windows should be placed with sills at least 4 feet above the floor. Windows listed in a standard millwork catalogue should be selected for the dairy barn, as they are less expensive than specially ordered windows.

When electric service is available, it is recommended that 100-watt lamps equipped with R.L.M. porcelain enameled reflectors spaced 10 to 15 feet apart be placed on the ceiling over each feed and litter alley. The lights in the feed alley should be staggered with those in the litter alley and controlled by switches placed in a convenient location near the doors. If the barn has two entrances the lights should be controlled by three-way switches.

Careful thought should be given to the wiring layout of the barn. Number 12 nonmetallic sheath-covered cable is probably more satisfactory than any other type of wiring system as it is moisture-proof. Convenient outlets should be placed where it may be desirable to plug in appliances such as motor clippers, milking machines, and cleaning and sterilizing equipment.

### Dairy Barn Construction

The plan in Figure 4 is for a one-story 34- by 60-foot, 20-cow milking barn with two box stalls, bull pen and feed room. This plan provides for 2 rows of cows facing out with an 8-foot central litter alley. The milking section may be completely isolated from the box stall section by extending the partition.

A floor plan of a dairy barn with limited overhead capacity for hay storage is shown in Figure 5. This barn provides space for 24 cows, calf pen, bull pen, cow pen, feed room, and a loft with a

capacity for 45 tons of loose hay. The barn may be constructed of either wood, tile, or concrete blocks with a ½ story gambrel roof.

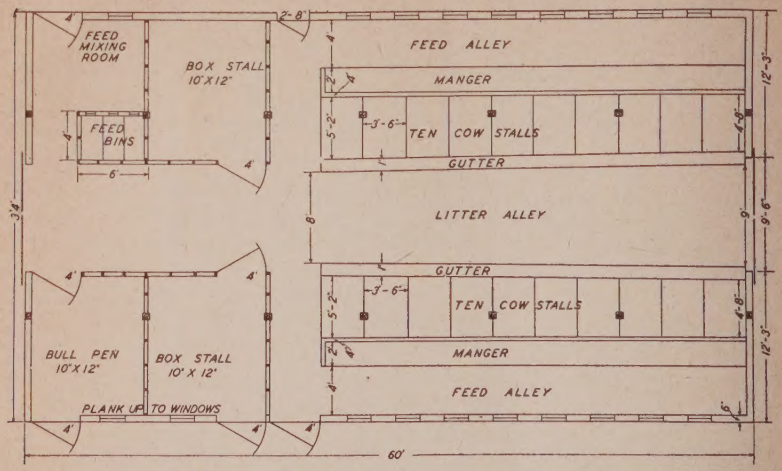



Figure 4.—One-story, 20-cow milking barn. (Plan .723-4)

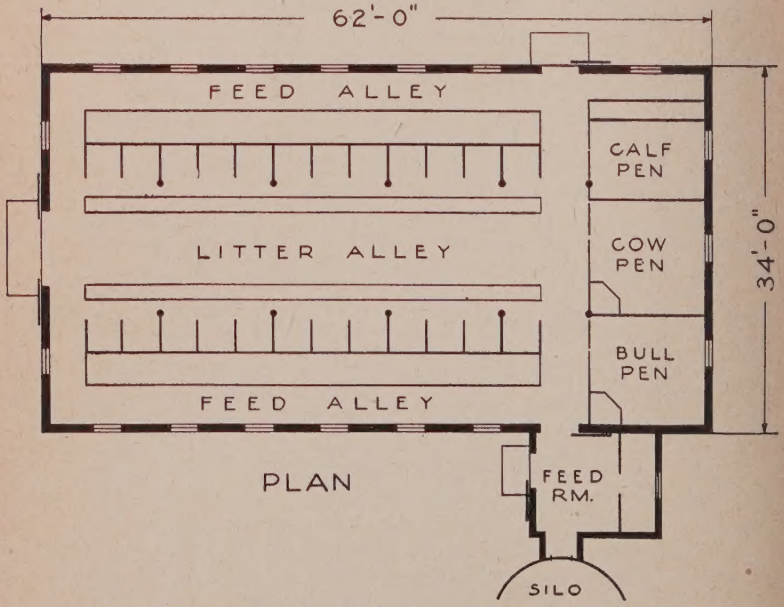



Figure 5.—Floor plan of a typical average-size dairy barn. The lay-out is designed so that ultimately standard commercial metal equipment may be installed. (Plan .723-30 or U.S.D.A. 3220) For further details refer to U. S. Department of Agriculture Leaflet No. 232, *A Wartime Dairy Barn.*

## Shelter Sheds and Milking Parlors

The majority of Idaho dairymen find that an open shed and milking parlor is a satisfactory method of handling herds from 10 to 30 cows. The open shed as shown in Figure 6 may be used for this purpose, and may be built of framed construction with vertical boards and batten, or of studding and horizontal siding. The latter construction is recommended for the combination walk-through plan as shown in Figure 7.

The shed should be constructed with a concrete foundation on three sides and extended 15 feet on the open side. The milking section may be ceiled completely inside with either shiplap or plywood, and provided with a concrete floor.

The milkhouse and the milking parlor may be located at either end of the shed, and the doors arranged to suit the chore route on the individual farm. If the shed is modified to include six stanchions, a lean-to feed room may be placed in any convenient location similar to Figure 7. In the walk-through parlor the milking stalls are constructed of wood. When a tandem arrangement is used it will be necessary to build a separate milking parlor as shown in Figure 8 in which welded pipe construction is used for the stanchion and pens.

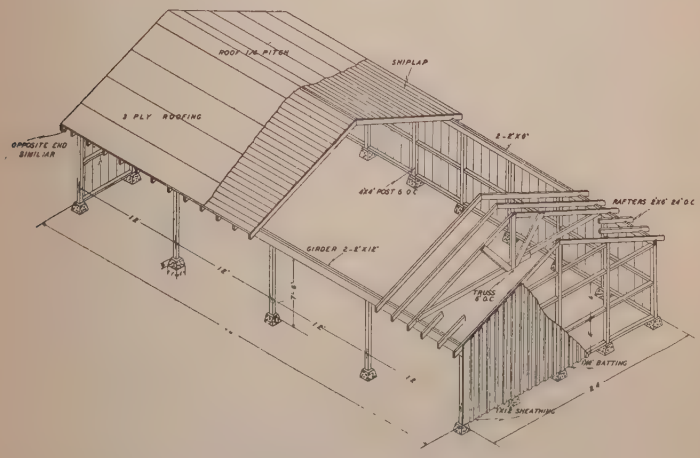



Figure 6.—Frame shelter shed. (Plan .721-15)

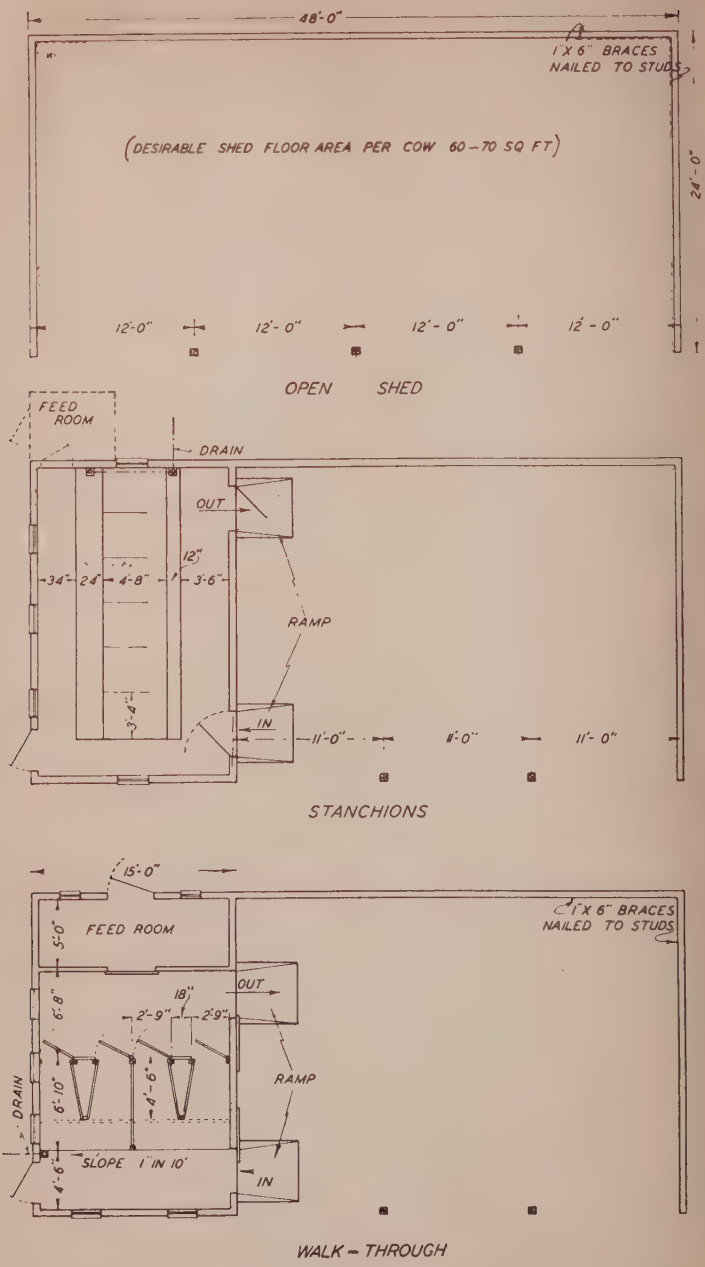



Figure 7.—Floor plans. (Plans .721-15, .721-16A, .721-16B)

## Tandem Milking Barn Arrangement

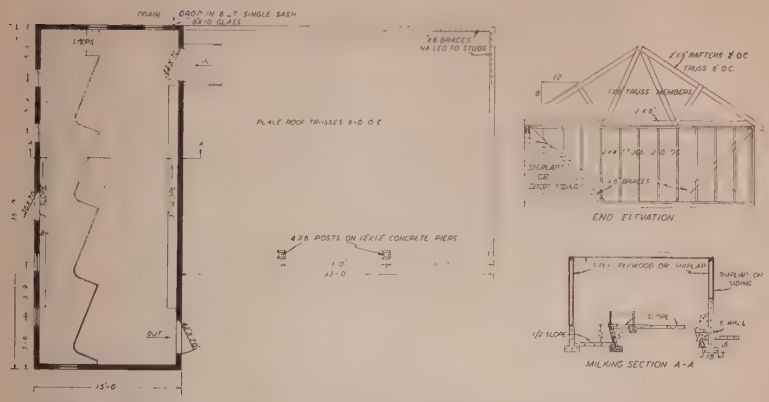



Figure 8.—Floor plan of a tandem-type milking barn with four stalls. Although the space required per unit is greater, time and labor is saved during the milking operation with this arrangement. (Plan .721-16C)

## Shelters and Feed Storages

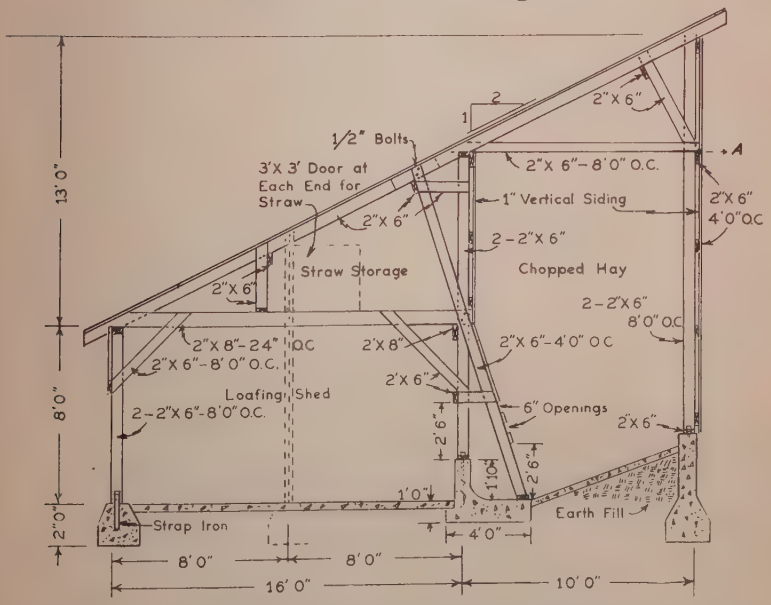



Figure 9.—Chopped hay storage and loafing shed may be used with milking barn. Capacity of chopped hay is 2 tons per running foot for the gable-type of construction, and 1 ton per foot for the shed-type. (Plan .724-8)

Figure 10.—The shelter provides protection for the manger and a dry feeding floor for the cattle.

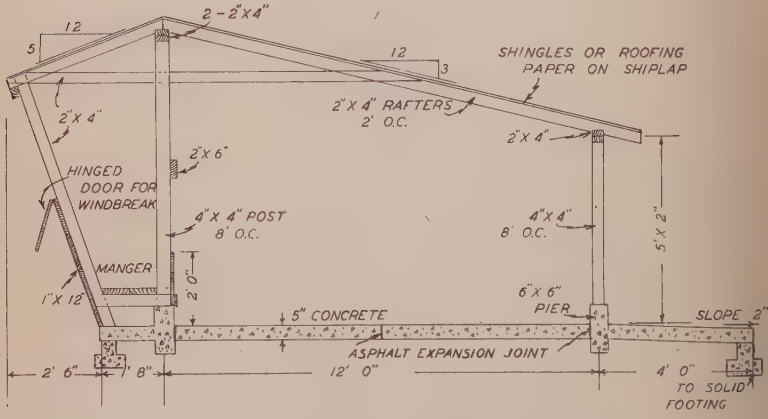
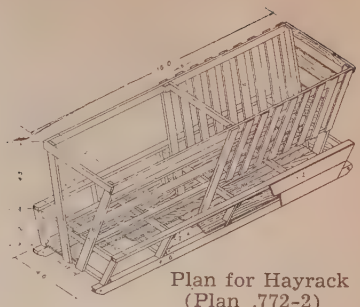



Figure 11.—Hay feeding shelter. (Plan .724-10)

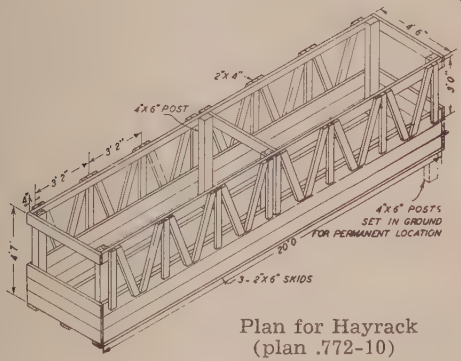
Two types of hayracks are illustrated in Figure 12, a permanent rectangular rack and a portable V-type hayrack. The rectangular rack may be made portable by building the rack on suitable skids. Both racks are designed for feeding long hay.

## Hay Feed Racks

Hayrack



Plan for Hayrack
(Plan .772-2)




Plan for Hayrack
(plan .772-10)

Figure 12.—Hayracks.

Figure 13.—Chopped hay feed rack.

The circular hay feed rack in Figure 13 is large enough in diameter to allow the hay to be stacked inside the rack. Such an arrangement reduces hay wastage and the labor of replenishing the rack to a minimum, as the hay is moved only a few feet from the stack to the inside of the feed rack.

A very inexpensive but practical feed rack for feeding either long or chopped hay may be constructed of poles and scrap lumber generally available on the average farm. This rack may be constructed so that the cows may feed from one or four sides, whichever arrangement best suits the individual condition.

Figure 14.—A practical and inexpensive feed rack for either long or chopped hay.

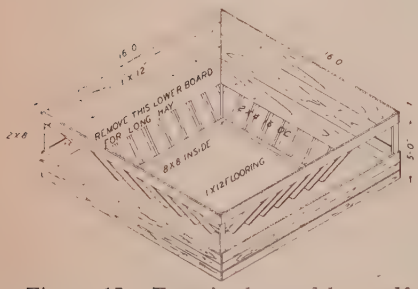



Figure 15.—Egger's chopped hay self-feeder for cattle. (Plan .772-6)

A large-capacity, chopped-hay feed rack is illustrated in Figure 15. This rack may also be used for feeding long hay by simply removing the board, as noted in the drawing. A feed rack of this type reduces to a minimum the manual labor of feeding hay to a dairy herd, as a large quantity of hay may be handled at one time.

## Calf Barns

A gable-type barn to accommodate 15 to 20 calves is shown in Figure 16. Two community pens 8- by 10-feet are provided on one side of the feeding alley, and 6 individual pens 4- by 6-feet on the opposite side. The pen arrangement may be changed by movable panels to suit individual requirements. Mangers or stanchions are optional for the large pens, but stanchions and feed boxes are recommended for the individual pens.

An 8- by 10-foot storage room is provided at one end of the barn with a door opening into the feed alley. Outside doors are provided for each pen. The floors are constructed of concrete with drainage to the pen doors.

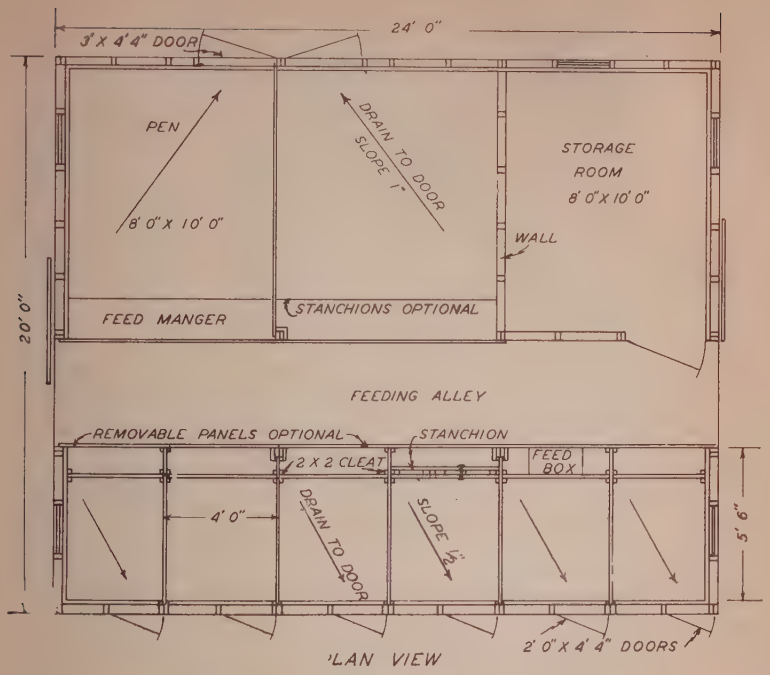



Figure 16.—Calf barn. (Plan .723-29)

The safe keeper bull pen in Figure 17 has been designed by the U. S. Department of Agriculture primarily for handling unruly and vicious bulls. The pen includes a shed with stanchion and manger, the latter being reached from a feeding alley. A sliding door, opening into a yard, is operated with ropes from the feeding alley so that the bull can be shut in the adjoining yard while the stable is being cleaned. A gate and breeding rack are placed in the yard, and in order to allow yard space enough for the bull to get exercise, it is recommended that the yard be made 100 to 150 feet long.

Under no conditions should a bull be placed in a yard or pasture that does not have a substantial fence at least 5 or 6 feet high. A solid fence is not recommended except for extremely vicious bulls. Many bulls get their exercise by continually working at the fence. Damage to the fence may be prevented by using a single wire and an approved electric fence controller. Locating the wire about 12 inches from the fence and 3 feet from the ground should provide the necessary protection.

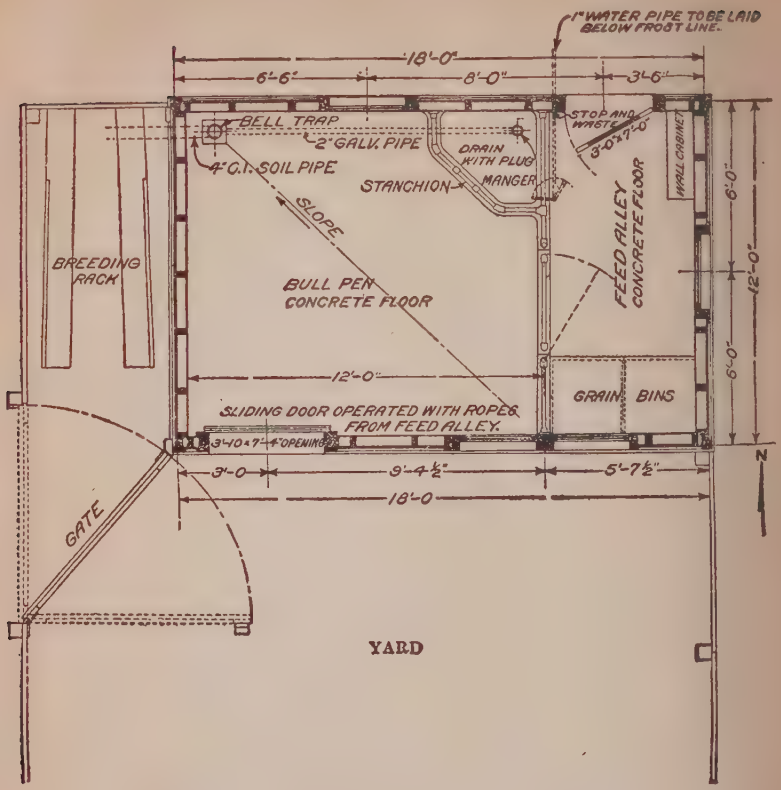



Figure 17.—Safe keeper bull pen. (Plan .723-1)

## Stalls and Stanchions

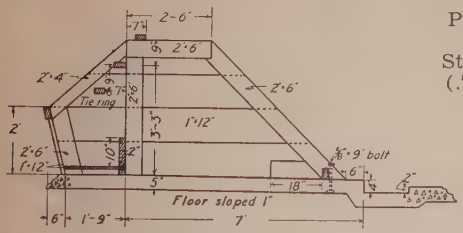
The model and modified model cow stalls shown in Figure 18 are inexpensive and comfortable types of stalls. They require less bedding, keep the cows cleaner, and reduce labor in cleaning barns. These stalls are recommended where cows are kept in the barn and the open-shed system is not used. The modified stall does not obstruct the light in the barn as badly as the model stall, and the manger is better suited to feeding chopped hay.

An inexpensive and practical calf stanchion for the calf pen is shown, and also a special method of constructing wooden stanchions which may be replaced by steel when the material is available.

## Milkhouse or Room Construction

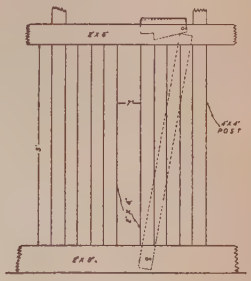
"There shall be provided a milkhouse or room in which the cooling, handling, and storing of milk and milk products and the washing, bactericidal treatment, and storing of milk containers and utensils shall be done. (a) The milkhouse or room

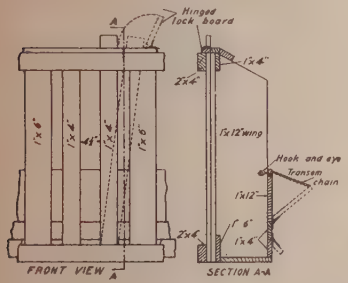
shall be provided with a tight floor constructed of concrete or other impervious material, in good repair, and graded to provide proper drainage. (b) It shall have walls and ceilings of such construction as to permit easy cleaning, and shall be well painted or finished in an approved manner. (c) It shall be




Plan for Modified Model Stall (.7231-2)

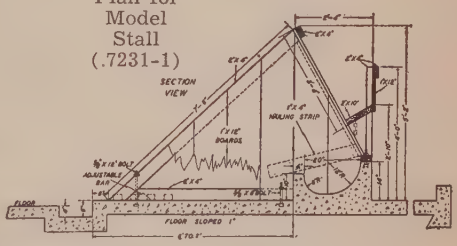
Plan for Rigid Stanchion (.7231-4)

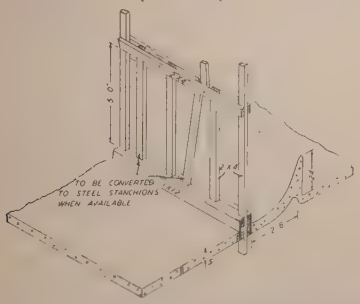





Plan for Calf Stanchion (.7231-3)

Plan for Model Stall (.7231-1)




Plan for Wood Stanchion* (.7231-18)

Figure 18.—Stalls and Stanchions.

* Courtesy, The Louden Machinery Company

well lighted and ventilated. (d) It shall have all openings effectively screened including outward-opening, self-closing doors, unless other effective means are provided to prevent the entrance of flies. (e) It shall be used for no other purposes than those specified above except as may be approved by the health officer; shall not open directly into a stable or into any

room used for domestic purposes; shall, unless the milk is to be pasteurized, have water piped into it; shall be provided with adequate facilities for the heating of water for the cleaning of utensils; shall be equipped with two-compartment stationary wash and rinse vats, except that in the case of retail raw milk, if chlorine is employed as the principal bactericidal treatment, the three-compartment type must be used; and shall, unless the milk is to be pasteurized, be partitioned

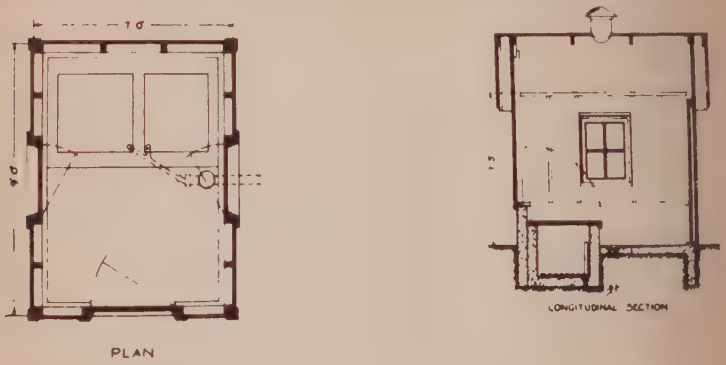



Figure 19.—One-room milkhouse. (Plan .752-8)

to separate the handling of milk and the storage of cleansed utensils from the cleaning and other operations, which shall be so located and conducted as to prevent any contamination of the milk or of cleaned equipment."—*U. S. Public Health Service Milk Ordinance.*

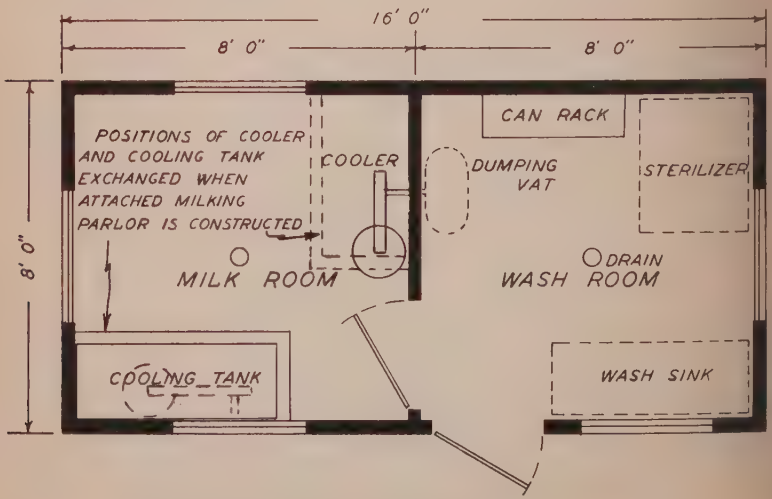



Figure 20.—Two-room milkhouse. (Plan .752-7)

Adequate light is needed in the milkhouse, and it is recommended that window area equivalent to 10 percent of the floor area be provided. When electric service is available 60- or 75-watt lamps in porcelain enameled reflectors should be mounted on the ceiling in the center of the room or rooms. Since the interior of the milk-

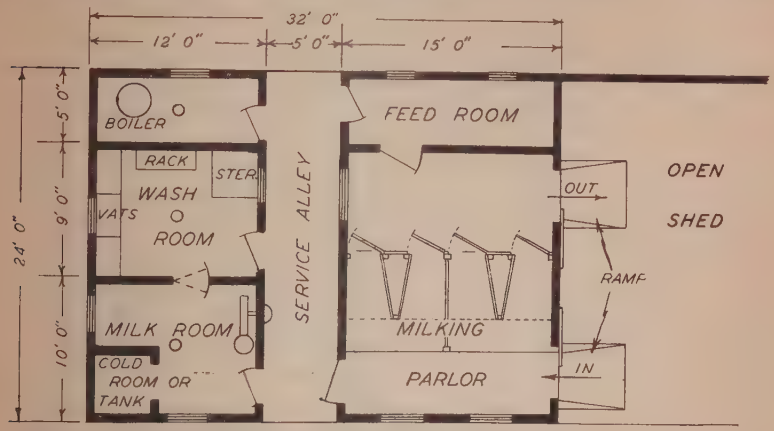



Figure 21.—Combination milkhouse and milking parlor. (Plan .752-9)

house is subjected to considerable moisture, nonmetallic, sheath-covered cable should be used for the wiring.

Electric service is of great benefit to the dairyman both in the barn and the milkhouse. There are on the market at the present time several efficient electrically operated water heaters and sterilizers which will save the dairyman much time and labor.

Proper ventilation is necessary to keep the air in the milkhouse dry and fresh. Screened openings such as windows and doors are

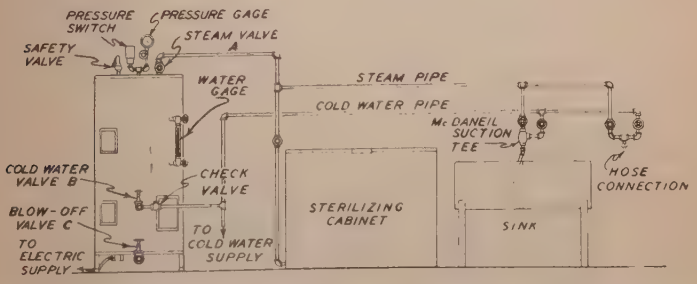



Figure 22.—Diagram for an electric steam accumulator. (Plan .3243-3)

not always adequate and it may be necessary to provide a forced system of ventilation. To rid the milkhouse of steam and vapor arising from the washing and sterilization of milk utensils and to cause the walls, ceiling, and floor to dry quickly, an electrically

operated outtake fan is recommended. For further information refer to U. S. Department of Agriculture Farmers' Bulletin No. 1214, *Farm Dairy Houses.*

Where ordinances require a milkhouse separate from the barn, a simple, well-ventilated structure as the one in Figure 19 with

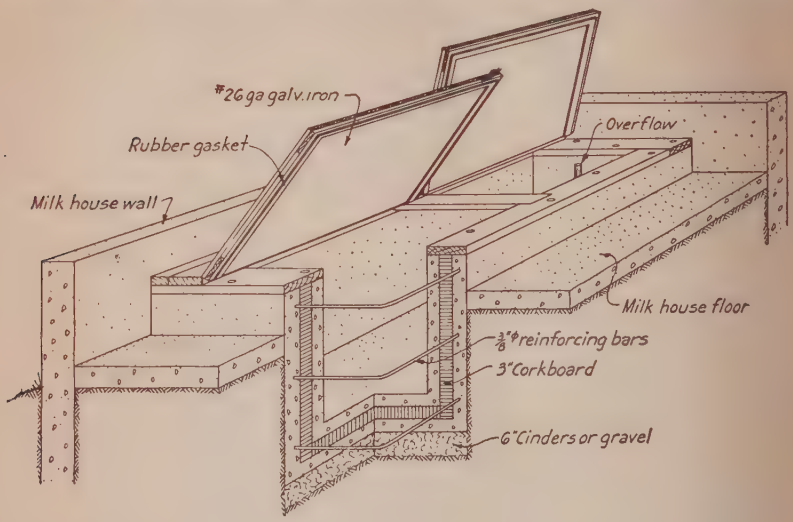



*Figure 23.—Deep-sitting concrete milk cooling tank. (Plan .845-19)

* Courtesy, Portland Cement Association.

concrete floor and drain will be adequate. The lower walls are of concrete and the upper of studs covered with horizontal siding. Screens should be used at windows and door. The concrete tank will hold 8, 10-gallon cans and is designed for water-cooling, but

## Table 2

**Milk Cooling Tank for Cold Water or Mechanical Refrigeration**

| Capacity of tank | | | Capacity in gallons | Inside length in feet | Inside width in inches | Inside depth including plates in inches |
|---|---|---|---|---|---|---|
| Total storage capacity 40 qt. cans | Cans cooled per milking one cooling daily 40 qt. cans | Cans cooled per milking two coolings daily 40 qt. cans | | | | |
| 4 | 4 | 2 | 160 | 4 | 36 | 28 |
| 6 | 6 | 3 | 240 | 6 | 36 | 28 |
| 8 | 8 | 4 | 320 | 8 | 36 | 28 |
| 10 | 10 | 5 | 400 | 10 | 36 | 28 |
| 12 | 12 | 6 | 480 | 12 | 36 | 28 |

NOTE: Where night's milk is allowed to remain in the tank while morning's milk is cooled, a tank large enough to hold the cans from *two* milkings is needed. Where only the night's milk is cooled or where the cooled milk is taken out to make room for the morning's milk, the tank need be only large enough to hold the cans from *one* milking.

mechanical refrigeration could be used. Before selecting plans for a milkhouse, the local dairy inspection agency should be consulted regarding sanitary regulations.

A plan for a 2-room, 8- by 16-foot milkhouse designed primarily for farms marketing cream is shown in Figure 20. The house has ample capacity for 40 to 60 cows, depending on the method of handling the milk. If adequate refrigeration is provided it may be used on market milk dairy farms having 20 to 40 cows.

Present trends are toward a combination milkhouse and milking parlor constructed under one roof with an alley separating the two units. This arrangement will satisfy most sanitary requirements if the milking unit is properly cleaned and feed storage is eliminated. Figure 21 illustrates a combination milkhouse and milking unit that may be modified to suit individual conditions.

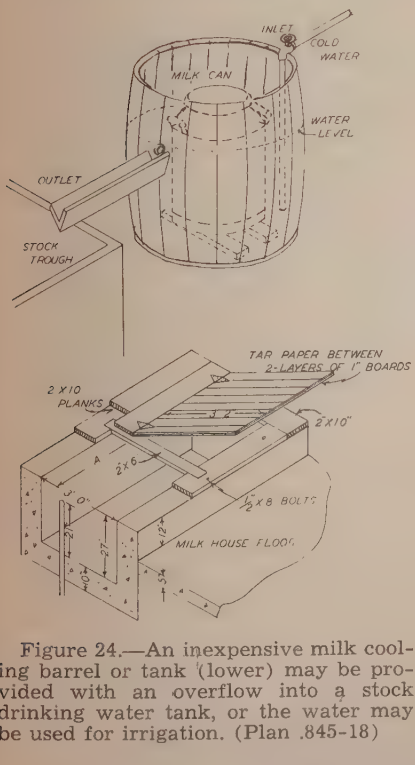



Figure 24.—An inexpensive milk cooling barrel or tank (lower) may be provided with an overflow into a stock drinking water tank, or the water may be used for irrigation. (Plan 845-18)

If it is desired to use an oil-, coal- or wood-fired boiler for heating water a special room may be provided. When an electric steam accumulator is used the boiler room may be eliminated and the apparatus installed in the wash room. A plumbing diagram for an electric steam accumulator as used for dairy sterilization is shown in Figure 22. A 30-gallon unit with a 1500-watt heating element produces about 30 pounds of steam for sterilizing twice in 24 hours. This is enough steam to sterilize the dairy utensils and equipment for a 20- to 30-cow herd and under average kilowatt-hour rates the cost is about 15 cents per day for operation.

Production of high-quality milk demands that milk be cooled quickly and kept at a low temperature until delivered. High bacteria counts are often traceable to high holding temperatures. Bacteria grows very rapidly at a temperature of 70° F. or above, but very slowly at a temperature of 50° F. or lower. Quick and proper cooling of milk will retard the development of the bacteria that is largely responsible for poor quality.

Many dairymen use mechanical refrigeration for cooling and storing milk between regular periods of delivery. Brine coolers and wet storage cabinets provide the type of equipment that makes prompt and proper cooling of milk possible. A deep-sitting concrete tank similar to the one shown in Figure 23 is recommended when cold water or mechanical refrigeration is used for cooling milk in cans. Such a tank will give the quick cooling so essential in the production of high quality milk. The dimensions and various capacities are shown in Table 2.

Figure 25.—Plank construction may be used for a 6-can yard or roadside tank. (Plan .845-20)

## Labor-Saving Equipment

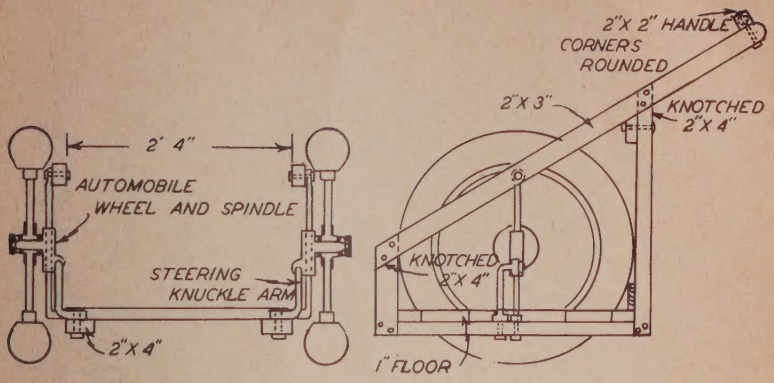



Figure 26.—Farm-made milk can cart. (Plan .7521-2)

The cart is constructed of ordinary automobile wheels and spindles, and is built large enough to handle 4, 10-gallon cans. The cart may be used to haul the cans from the barn to the milkhouse, and from the milkhouse to the roadside stand.

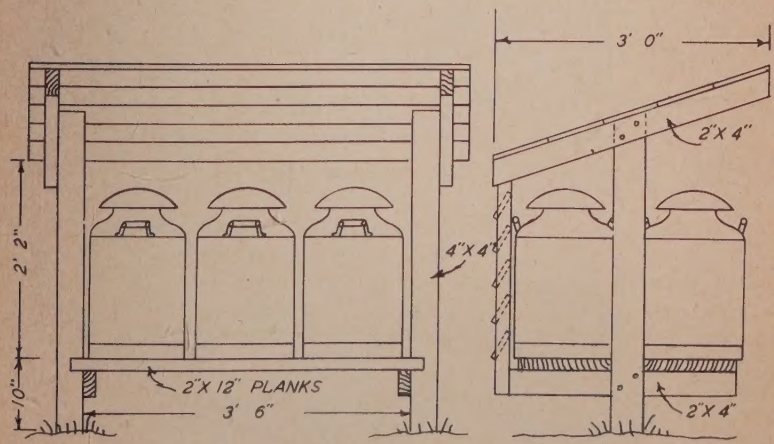



Figure 27.—Roadside shelter. (Plan .7521-2)

A roadside shelter for protecting the cans from the sun may be built from scrap lumber using a 2-inch plank floor, with a roof of shiplap or shingles.

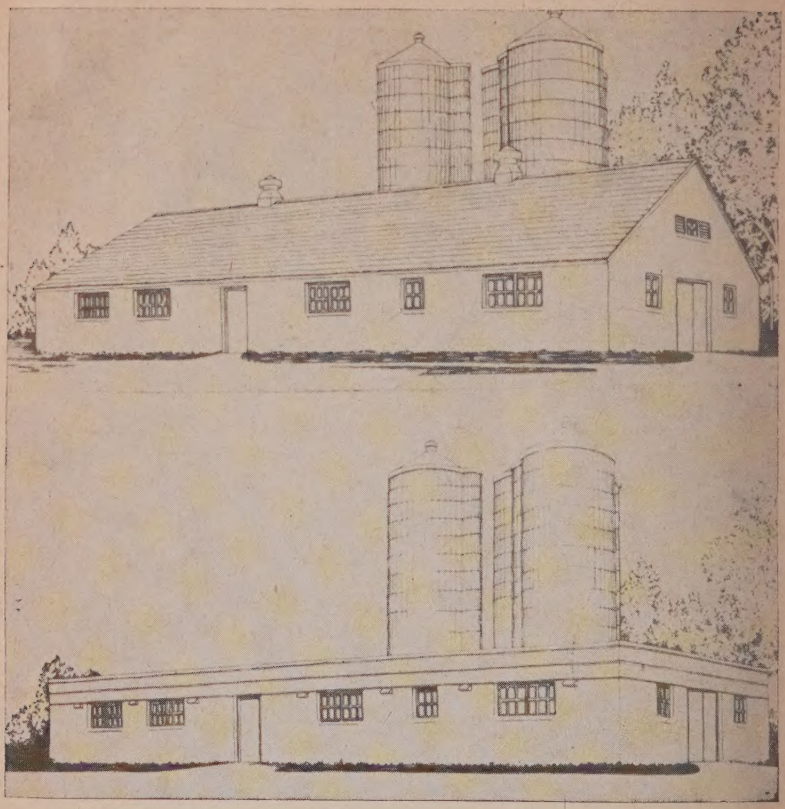


*Figure 28. — Exterior views, firesafe modern concrete dairy barn. (Plan .723-31)

A modern, firesafe, concrete dairy barn of one-story construction is illustrated in Figure 28. This practical one-story barn meets all modern requirements of sanitation, good lighting, insulation, and ventilation. Either of two types of exterior construction, namely, the gable or flat roof, may be used with the same floor plan.

* Courtesy, Portland Cement Association.

# Dairy Barns and Equipment Plans

**Available from**
**Department of Agricultural Engineering**
**University of Idaho**
**Moscow, Idaho**

## Dairy Barns and Milkhouses

| Plan No. | Size | Description | Price |
|---|---|---|---|
| .723-1 | 12x18 | Bull pen, feed alley, 2 grain bins, iron stanchion | $0.60 |
| .723-2 | 18x30 | Barn, 2-story, 4 cow stalls, calf pen, 5-ton mow | 0.30 |
| .723-3 | 34 wide | Barn, 8 floor plans, for use with feed barn | 0.80 |
| .723-4 | 34x60 | Barn, 1-story, 20 stalls, 3 box stalls, 1 feed room | 0.60 |
| .723-5 | 34x50 | Barn, capacity 24 cows, 2, 14′ silos, feed and milkroom | 0.60 |
| .723-12 | 26x50 | Calf barn, 2-story, concrete floor, to use with .723-13 | 0.60 |
| .723-13 | 18x36 | Isolation barn, 2-story, to use with .723-12 | 0.60 |
| .723-14 | 28x66 | Calf barn, frame construction, insulated walls, gambrel roof, with windows and ventilators | 0.60 |
| .723-15 | 48x68 | Dairy barn, gambrel roof, shawver truss, mow, milking barn wing, milkhouse, office rooms and feed grinding unit | 4.00 |
| .723-15P | | Pictorial and floor plan of .723-15 | 0.10 |
| .723-24 | 12x18 | Bull barn, 2-pen, frame construction, gable roof | 0.60 |
| .723-25 | 17x18 | Barn, 10 cow stalls, milkroom, feed room, shed roof | 0.30 |
| .723-26 | 16x32 | Bull barn, exercise lots, 2 bulls, safety features | 0.30 |
| .723-27 | 19x45 | Milk barn and house, 30 to 60 head, cold room, etc. | 0.30 |
| .723-28 | 18x69 | Milking barn, 1-string, milk and wash rooms, feed storage | 1.50 |
| .723-29 | 20x24 | Small calf barn, outside doors, individual pens | 0.30 |
| .723-30 | 34x62 | Victory dairy barn, 1½-story, gambrel roof, for wood, tile or concrete block construction | 1.50 |
| .723-31 | 34x60 | Dairy barn, 1-story, gable roof, cinder block construction | 0.30 |
| .752-1 | 27x31 | Milkhouse, 3-room, 40 to 100 head, for certified milk production | 0.60 |
| .752-2 | 21x29 | Milkhouse, 3-room, 25 head, for small city bottling plant | 0.60 |
| .752-3 | 12x14 | Milkhouse, 1-room, 20 head, for butter making | 0.30 |
| .752-4 | 7x9 | Milkhouse, 1-room, cooling tank | 0.30 |
| .752-6 | 12x14 | Milkhouse, 3-room, 50 to 100 head, cold box | 0.30 |
| .752-7 | 8x16 | Milkhouse, 2-room, alternate arrangement for cooler and tank | 0.30 |
| .752-8 | 7x9 | Milkhouse, 1-room, for small herd, gable roof | 0.30 |
| .752-9 | 24x32 | Milkhouse and milking parlor, 3-room with service alley | 0.30 |

## General Barns and Sheds

| | | | |
|---|---|---|---|
| .721-2 | 34x96 | General barn, 2-story, 8 horse stalls, 20 cow stanchions, 2 pens, calf pen, bull pen, grain bins, open feeding shed | 2.00 |
| .721-3 | 56x64 | General barn, 8 horses, 5 cows, 65 sheep, ground-to-ridge mow | 0.60 |
| .721-5 | 72x20 | Livestock shed, built in 12′ sections | 0.30 |
| .721-7 | 24x30 | Feeding shed | 0.30 |
| .721-8 | 28x48 | Open shelter shed | 0.60 |
| .721-8A | 24x48 | Open shelter shed | 0.10 |
| .721-9 | 24x72 | Open shelter shed, concrete foundation, scissors truss, gable roof, frame construction, 6 windows | 0.30 |
| .721-10 | 20x60 | Cattle shed, 12′ bays may be added, closed 3 sides | 0.30 |
| .721-11 | 20x68 | Cattle shed, 20′x24′ ell, 50 head loose cattle | 0.30 |
| .721-12 | 24x60 | Feed shed, open side, feed racks, sliding doors | 0.30 |
| .721-15 | 24x48 | Livestock shed, open side, gable roof | 0.30 |
| .721-16 | 24x48 | Open shed | 0.30 |
| .721-16A | 24x48 | Open shed, milking section, capacity 6 cows | 0.30 |
| .721-16B | 24x48 | Open shed, 4 cows, walk-through milking section, feed room | 0.30 |
| .721-16C | 24x48 | Tandem milking parlor, 15′x36′ 4 walk-through pens, (Staggered) | 0.30 |
| | | Alternate plan, sheet 2 (In line arrangement) | 0.30 |
| .721-19 | 34x62 34x72 | General barn, floor plans, horse and cow stalls, alternate arrangement of litter and feed alleys | 0.30 |
| .721-20 | 36x62 36x72 | General barn, same as .721-19 only 36′ wide | 0.30 |
| .721-26 | | Cow stall details, for level and raised feed alley mangers | 0.30 |
| .721-27 | | Concreting cow stalls, in reference to .721-26 | 0.30 |
| .721-28 | | Horse, cow, and calf stall details | 0.30 |
| .724-8 | 26x40 | Chopped hay storage and feeding barn, capacity 40 tons | 0.30 |
| .724-9 | 40x52 | Chopped hay storage and feeding barn, gable roof, center storage with side feed manger and loafing areas, capacity 90 tons | 0.30 |
| .724-10 | | Hay feeding shelter, protection for manger and stock, can be made in lengths to accommodate individual herds | 0.30 |

## Equipment

| | | | |
|---|---|---|---|
| .3243-3 | | Electrical steam accumulator, plumbing diagram for dairy sterilization | 0.10 |
| .72012-1 | | Float for corrugating dairy floors | 0.10 |
| .7231-1 | | Model cow stall, on concrete manger and floor, 4 sizes | 0.10 |
| .7231-2 | 4x7 | Modified model cow stall, with 2′3″ manger | 0.10 |

| No. Plan | Size | Description | Price |
|---|---|---|---|
| .7231-3 | | Calf stanchion, adapted to pen feeding | 0.10 |
| .7231-4 | | Stanchion, convenient, inexpensive, adapted to barns and sheds | 0.10 |
| .7231-5 | | Stanchions, wooden construction, methods of attaching to post and girder supports | 0.30 |
| .7231-14 | | Hoof trimming rack | 0.20 |
| .7231-18 | | Stanchion, wooden construction, easily replaced with steel | 0.10 |
| ..7521-2 | | Milk can shelter and milk cart; shelter for 6 cans, wooden construction; cart, 2-wheeled, rubber-tired, 4, 10-gallon cans | 0.10 |
| .7251-3 | | Milk can rack, wooden construction, 2, 10-gallon cans and pails | 0.10 |
| .772-1 | 5x16 | Portable feed rack | 0.10 |
| .772-2 | 6x16 | Portable feed rack, troughs under, 1,000 lbs hay | 0.10 |
| .772-3 | 4x29 | Hay feed rack | 0.30 |
| .772-4 | 4x16 | Portable feed rack, 56" high, stanchion-type, 28 cows, also fence panel-type, timber construction | 0.20 |
| .772-5 | 4x16 | Portable feed rack | 0.30 |
| .772-6 | 16x16 | Chopped hay self-feeder for cattle, 5' high | 0.10 |
| .772-7 | 4x12 | Portable feed rack, 5' high | 0.20 |
| .772-8 | 4x20 | Portable feed rack, partition in center of rack, V-shaped feed openings | 0.10 |
| .772-9 | 7x16 | Portable feed rack for chopped hay | 0.30 |
| .772-10 | 5x20 | Stationary rack for long hay | 0.10 |
| .772-11 | 7x22 | Cattle feeding rack for long hay, V-type | 0.30 |
| .772-12 | 6x16 | Portable rack for chopped hay | 0.10 |
| .774-1 | 3½x8 | Dehorning chute, stationary crate | 0.20 |
| .774-2 | 4½x8 | Dehorning chute, 3 types of stanchion gates, movable side | 0.30 |
| .774-3 | 7½x8 | Dehorning chute, movable side, head slot in gate, sliding door | 0.20 |
| .775-1 | 4x9 | Breeding rack for cattle, adjustable | 0.10 |
| .845-18 | | Milk cooling barrel and tank, 1, 10-gallon can, uses tap water for cooling | 0.10 |
| .845-19 | | Milk cooling tank, deep-sitting concrete-insulated, brine or water cooling | 0.30 |
| .845-20 | | Milk cooling tank, 4, 10-gallon cans, 2-inch plank construction, cover | 0.10 |